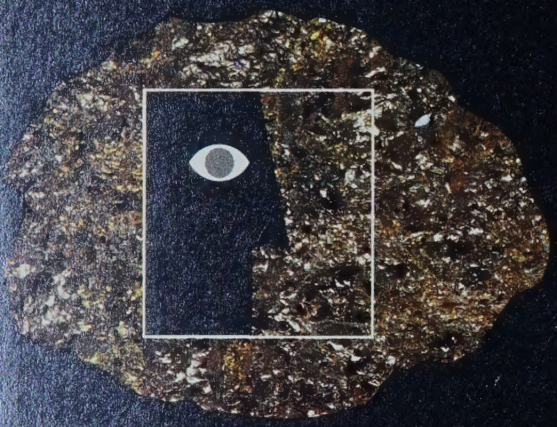
MAN AND NICKEL



COVER

Background for the cover illustration was provided by this piece of nickel ore which was formed in the Sudbury area about two billion years ago.

MAN AND NICKEL

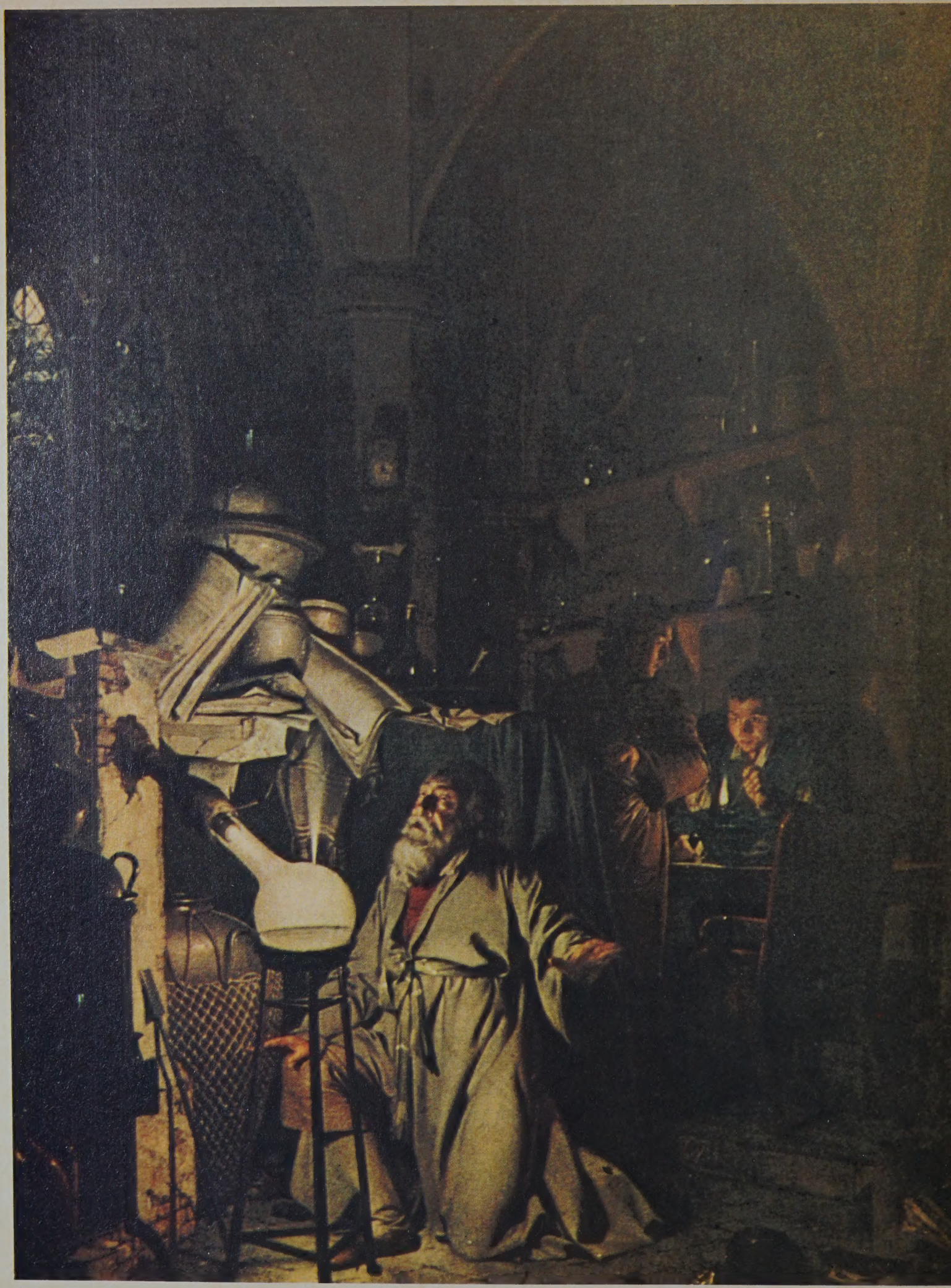
Since 1957, this story has been published each year by The International Nickel Company of Canada, Limited, to help bring to the people of Canada, and particularly the youth of our nation, a better understanding of the nature and importance of Canada's vast stores of mineral wealth.

There have been many separate printings, totalling more than 1½ million copies. Almost all of these were printed to answer requests from schools across Canada. We are proud to know that hundreds of thousands who were readers of the early editions are now in university or making their way in the world with a better knowledge of this great natural resource.

Contents

The International Nickel Company of Canada, Limited

Toronto Dominion Centre, Toronto 111, Ontario



Chapter 1

THE HIDDEN TREASURE

Spells! Magic! Secret formulae! These were the tools of the Alchemist, striving in his den to find the magical way to turn iron and lead into silver and gold. For centuries this was the dream of Man in his quest for the precious metals which Nature had hidden from his sight beneath the surface of the Earth.

Today Man has substituted science for magic and daring for spells, and with the tools of Knowledge has banished the Alchemist forever. Nature and her treasures are challenged today by the explorer, the prospector and the scientist. This book is the story of the challenge for one of the most valuable treasures of all . . . NICKEL.

Have you ever thought of the Earth as a great storehouse of hidden mineral treasure? Actually, it is a whole collection of storehouses, in which Nature has locked away most of the metals and other things that people for centuries have found useful, such as iron, coal, copper, lead, zinc and nickel. It is quite correct to call them treasures, because they play such an important part in our life today that we would not be able to get along without them.

The storing up of these valuable products began millions of years ago when most of the earth's interior was in a molten state. As the outside of the earth began to cool and harden, tremendous pressures were formed inside by the molten masses, and a great deal of buckling and twisting went on. Since there was no escape for much of the molten material, it was pushed this way and that, finally settling in pockets and veins. Canada is fortunate enough to possess more mineral deposits than most other parts of the world. Because our country was settled centuries after Europe and Asia, only in recent years have men located these storehouses and the valuable mineral in them.

Nickel is a part of that heritage—one of the greatest treasures that lie beneath the surface of Canada. It has a very exciting history, which is what we are going to tell you about in this book.

Like many other metals, nickel looks very unlike itself when it comes out of the mine. In fact, nickel ore and copper ore often look very similar, which is why nickel got its name. It happened like this: more than two hundred years ago some miners in Saxony were mining for copper, and they brought to the surface of their mine something which looked just like copper ore. Copper is a soft metal, easy to work with, and men had been using it for many, many years. But when they smelted down this ore

The alchemist works his magic. From the picture by Joseph Wright, reproduced by permission of the Derby Art Gallery, England.

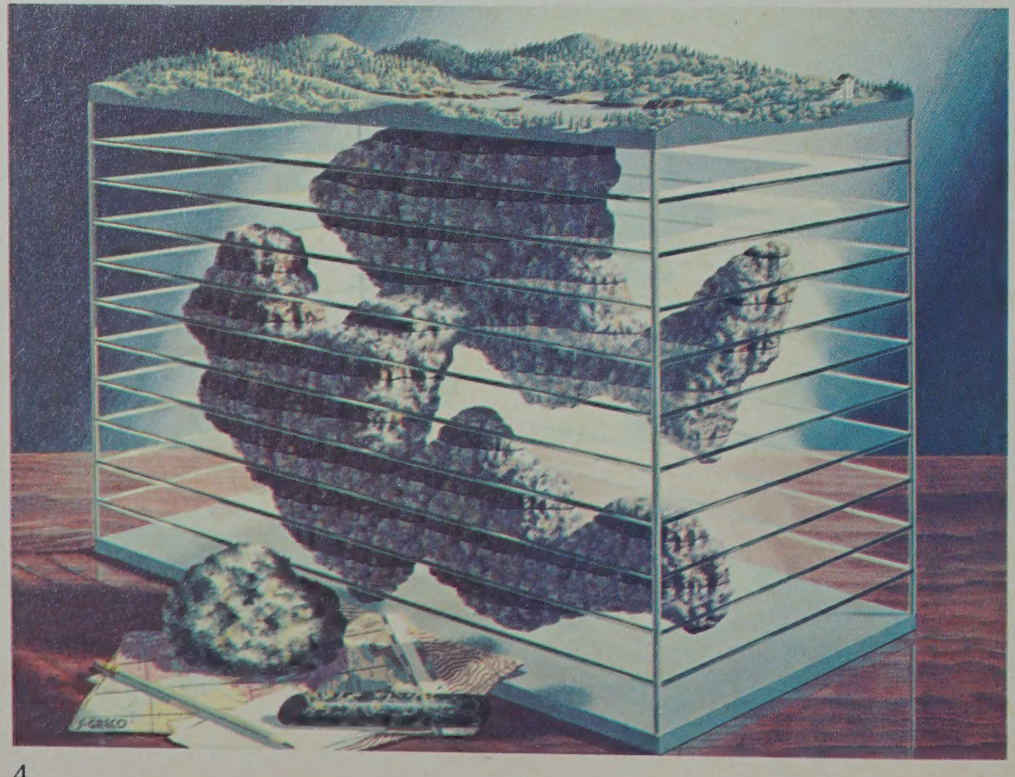
to get the metal out, they got a white metal that they didn't recognize. It certainly wasn't copper, and it was so hard they couldn't do anything with it. In those days, if a metal was not soft enough to hammer into the shape you wanted, it was not of much use.

Also, in those far-off days, people were very superstitious, and believed in spells and witchcraft. The Saxon miners thought that Satan—or Old Nick, as they called him—had cast a spell over their mine, and so they named this new metal "Old Nick's Copper" or, in their language, "Kupfer-Nickel".

Many years later, in 1751, a Swedish scientist named Cronstedt, after much research on this hard, white metal, found that it contained not only copper but a new metal altogether. So he dropped the "Kupfer" and called the new metal "Nickel".

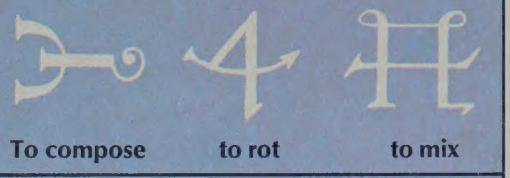
The next great problem was to find out how nickel could be used and from China came the first important clue. Since very ancient times the Chinese had been making lovely boxes and candlesticks from a white metal called "paitung". Now "paitung" was made by adding zinc to the metal obtained from nickel-copper ores similar to that which in Europe was called "Old Nick's Copper". When trade routes were opened with China in the seventeenth century, the East India Company brought back articles made of "paitung". Soon, vases and decorative pieces were being made in Europe by adding zinc to "Old Nick's Copper", which they then called German silver. Later, they found that other metals could be plated (coated) with nickel to give them a hard, bright surface. Then, in 1881, the first nickel coins were issued in Switzerland.

Now all this time men were getting nickel ore mostly from mines in Norway and in the South Seas. They had no idea that in the New World, in Canada, huge deposits of nickel ore were lying there unsuspected. There lay these great storehouses of treasure, some of the most valuable and useful in the world, hidden beneath the feet of roaming Indians and adventurous coureurs-des-bois.



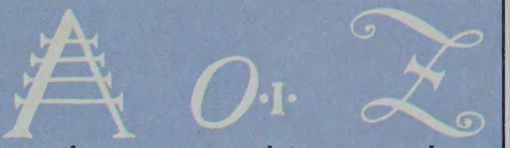
On left is symbolic model used by mining engineers to visualize size and shape of nickel ore deposits. Facing page (top) is altarpiece in St. Anne's Church, Annaberg, Saxony. Painted in 1521, it shows mining in the Erzgebirge where Kupfer-Nickel originated. Smelting illustration (below) is by Georg Agricola who lived in the area from 1490 to 1555. On right is Swiss 20-centimes nickel coin, first issued in 1881. Below, Chinese knife coins (twice size shown) contained nickel, and date back 2,000 years.

Symbols of the Alchemist

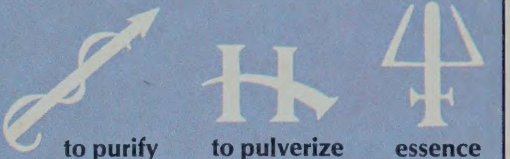


To compose — to rot — to mix

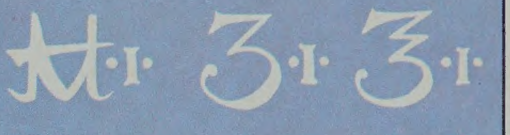
to take — to sublime — to filter



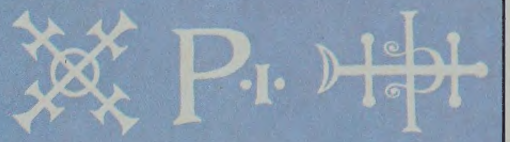
amalgam — one pint — to solve



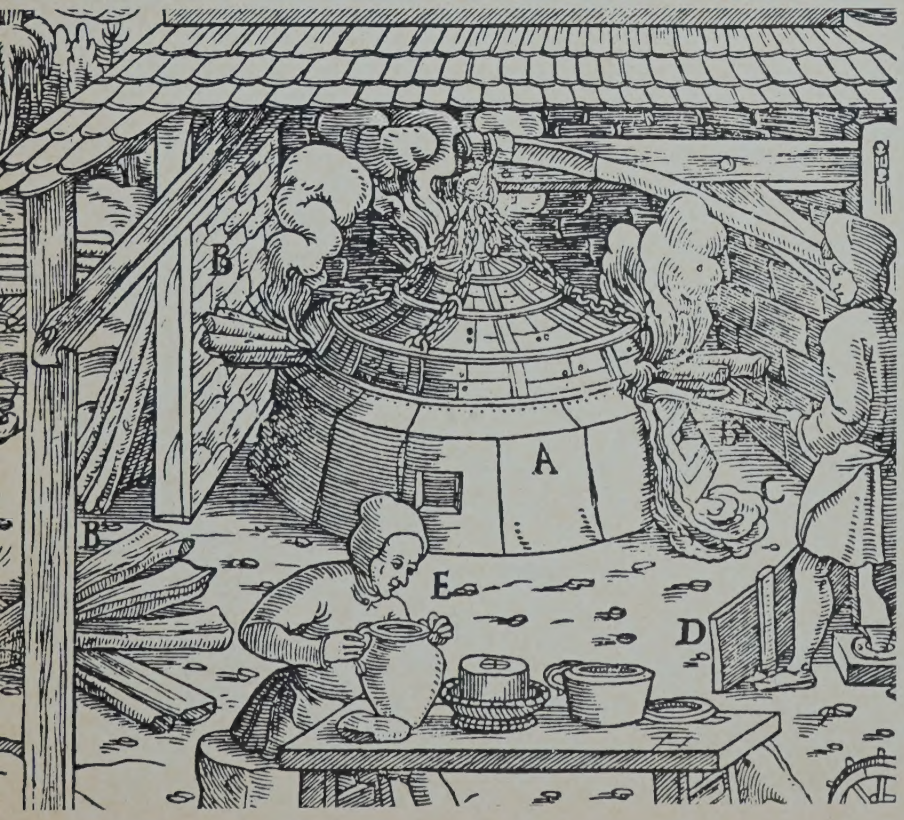
to purify — to pulverize — essence

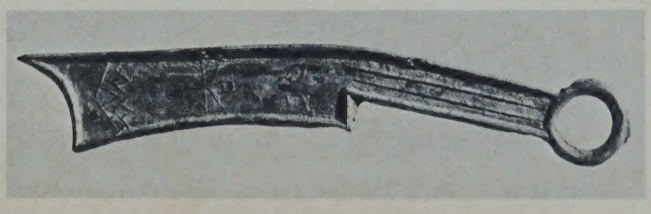


one pound — one dram — one ounce



torrefaction of gold — one pinch — torrefaction of silver





opening Copper Cliff Mine

R. Frood

-1886-

L. H Ashmun
Supt CCCo

H P. McIntosh
Treas.

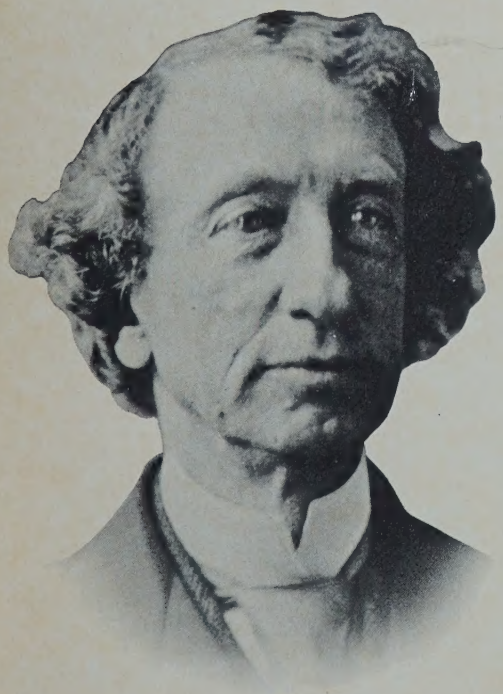
W. A Hooker

Archibald Blue.

Chapter 2

DISCOVERY AT SUDBURY

Fortunately many of those who came to Canada in the eighteen-hundreds were men of tremendous curiosity; they wanted to go where nobody had gone before and, when they got there, they wanted to see what there was of value. And they had a good reason: the Machine Age was getting into its stride, and more and more new materials *had* to be found. So men began probing, scratching and digging into the surface in many parts of Canada, looking for minerals . . . and then, as so often happens, one of the most important storehouses to Canada's future was unlocked by accident. It took place at the time when Canada was becoming a nation. Sir John A. Macdonald was doing all he could to bring the western part of Canada into Confederation. He had promised to build a railway which would reach right out to British Columbia, and the only way to get it through much of the rocky wilderness in Northern Ontario was to blast a way with dynamite. It was this blasting that uncovered a deposit of what appeared to be copper ore at a place near Sudbury.

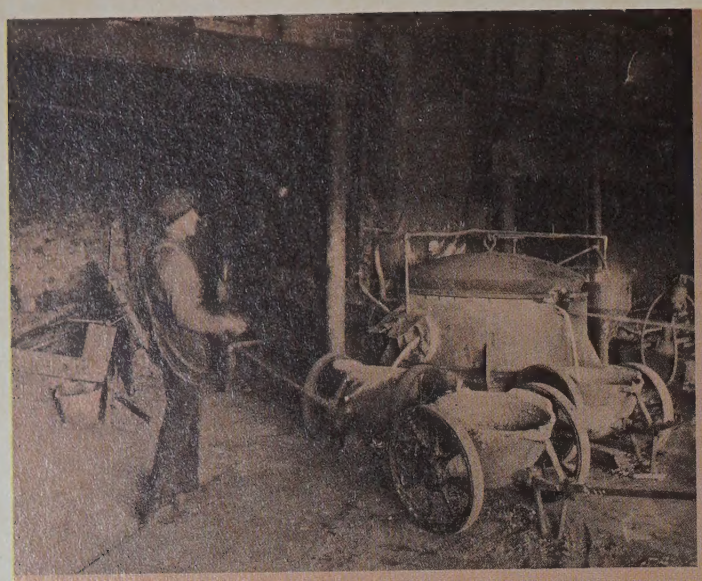


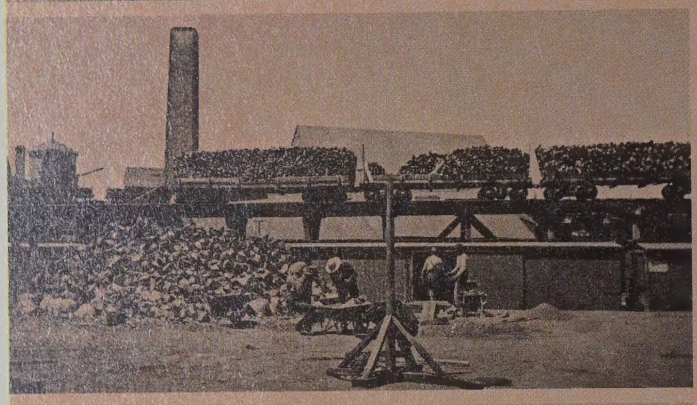
Sir John A. Macdonald (above) played a vital role in the development of the Sudbury discovery. On adjacent page, early photographers caught the spirit of those pioneering days. The famous name of Frood (top photo) is perpetuated as the man who discovered the Copper Cliff ore in 1885 and through the Frood-Stobie mine of today. Centre, the town of Sudbury as it appeared in 1888. Shown below is the first mining crew at the Murray mine.

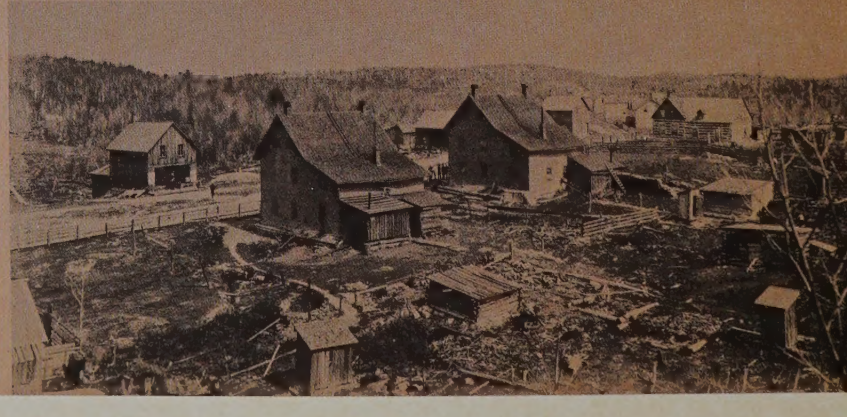
Immediately prospectors rushed into the area to stake claims, and several mines were started. Sir John A. Macdonald, one of the Fathers of Confederation, Sir Charles Tupper, and two of the men who helped build the C.P.R. — Lord Mount-Stephen and Sir William Van Horne — paid a visit to the new mining settlement at Sudbury, and because they could see how operations like this would help in the development of Canada's underground riches, they gave all the help and encouragement they could.

Even so, it looked at first as if the Sudbury District mines would have to close down right after they opened. The first batch of ore that was smelted down didn't produce pure copper at all; instead, it contained a large quantity of nickel. And in spite of the few uses that had been found for it, nickel was not in big demand and was thought of chiefly as a trouble-maker instead of a valuable metal, because it was difficult to separate from the copper. But, unlike the miners of Saxony a hundred years before, the owners of the Sudbury District mines said to themselves: "Why don't we find a new way to separate the nickel and develop new uses for it and therefore *make* it valuable?"

The Canadian Government saw the wisdom in this idea and even sent Sir Charles Tupper over to Europe, with Samuel J. Ritchie of the Sudbury District mines, to interview chemists and manufacturers and interest them in finding uses for the new metal. They learned that a Scotsman had discovered that by mixing nickel with iron in the making of steel, the steel became much tougher than any steel produced before. Immediately manufacturers found uses for this new, tough steel — and then came new







problems for the Sudbury District mines.

It was found that to separate the nickel from the copper was so expensive that it cost more to produce the nickel than people were willing to pay for it. Experiments went on for months and finally an economical separation process was discovered. This was the Orford process, which served so well for many years. But as soon as this problem was solved, another one stood in the way: the Canadian Copper Company at Copper Cliff was running out of money.

At this point Sir John A. Macdonald and Sir Charles Tupper stepped in again. Two great European companies, with millions to spend, made offers to buy out the company. The Canadian Copper Company didn't want this, but they had no money, so what were they to do? Macdonald and Tupper, who had a great deal of influence in Canada in those days, gave them so much encouragement and support that they were finally able to borrow from the banks the money they needed to make the company independent of outside help. They put in the equipment they needed, produced more and more nickel, and as the demand for it was developed all over the world they were able to sell larger and larger quantities at a profitable price. The nickel industry was saved for Canada.

By 1902 the Canadian mines were producing five thousand tons of nickel annually. The industry was growing at such a rate that finally the Canadian Copper Company at Copper Cliff, and the refinery in the United States, where the Canadian ore was refined, decided to amalgamate, and that was the beginning of the International Nickel Company, (incorporated in New Jersey). In order to consolidate the new company's mining interests in Canada, The International Nickel Company of Canada, Limited was formed in 1916 a subsidiary of the New Jersey company and, in 1928 became the parent company. Today it produces more nickel than any other company in the world.

Now you can see in this short history of nickel how many different kinds of men have played their part in unlocking this great storehouse which lies beneath the surface of Canada. The explorer went out into the northern wilderness to see what was there; the prospector followed him to find out how much was stored away; then came the mining and metallurgical engineers to show others how to get the ore out and how to refine it. Next came the statesman to give support and encouragement, the investor to provide the money, the research man to develop new uses for the nickel, and the businessman to provide the organization. Thus you see that in order for any business venture to grow and prosper, it takes the combined efforts of many men of different skills working in an atmosphere of friendly cooperation with the government. Back of them all stands the investor who risks his savings to help build the business; and for this risk is entitled to a fair return on the money he invests. In today's operations of Inco (the shortened version of The International Nickel Company of Canada, Limited) all these men still play their part, not only for the benefit of the company but for the benefit of Canadians throughout the land.

These rare pictures of Copper Cliff before the turn of the century show (on left, from top): tapping matte concentrate and slag from the mine's first smelter; matte from the small pots being loaded into boxcars; trainload of cordwood for the ore roasting process; breaking and stockpiling matte in the smelter yard. Right (from top): matte from blast furnaces being poured on the open ground for cooling and break-up; the old East smelter laboratory; general view of the mine in 1896; boarding houses opposite the small combined store and post office.

TAMING THE WILD

We think the story of nickel is pretty exciting. But then the whole story of Canada is exciting, and nickel fits right into the picture. Think of some of the chapters of Canadian history: the early explorers, pushing out into the unknown wilds, not knowing what they would find; the fur traders, travelling overland and by canoe as far north as the Arctic Circle, and right over the Rockies to establish their trading posts; the Mounties, who brought law and order to the western plains; the prospectors who sought gold and other metals locked away in the rocks; the bush pilots, who extended the fields of discovery ten or twenty times farther in just a few years.

All these people belong to Canadian history, and among them are those pioneers of Sudbury who had to push back what was then the northern wilderness in order to build homes and establish communities while wresting the ore from the earth. But history isn't simply what you read in books about past days; history is Now. We in Canada are part of it, and to show you more of the part that International Nickel is playing in it we want to tell you the Thompson Story, which is a modern version of the times and excitement of the great Sudbury discovery.

Knowing that no mine lasts forever, Inco started searching for new orebodies in Canada, long before World War II. Much of the hunting for nickel went on in Northern Manitoba. Because the wilderness of the country made exploration on the ground too difficult and slow, the company's geologists took to the air. They used all the new tools that science had given them, including flying magnetometers, like the one pictured on page 30. After many millions of dollars had been spent over ten hard years, they made their strike. The place was 400 air miles due north of Winnipeg, and 260 air miles from the Hudson Bay port of Churchill: the year was 1955.

Diamond drilling, to check the size and mineral content of the orebody, went on for a year, and in December, 1956, Inco decided to go ahead with development.

There were many problems and hazards! There were no roads, no trails; only vast areas of forest and muskeg. Every single thing, from nails to bulldozers, had to be taken in that winter over the frozen ground by tractor trains. The "Snowball Express", as it was called, ran 24 hours a day, seven days a week, on the 70-mile round trip from the nearest point on the C.N.R.'s Hudson Bay Line, and all that summer of 1957 other crews rushed to complete a railway spur to the new mining development. On October 20 the last spike was driven, and men and materials began to pour in.

Picturesque dress and equipment (top left) of these 1886 surveyors and pioneers, who helped to open up the Sudbury district, contrasts sharply with the pioneers of the ore strike at Thompson, Manitoba, in the 1950's. Other pictures show claim-staking in the Thompson area in 1956; diamond drilling rig at the site; snow train bringing in supplies over the frozen land; construction of the railroad into Thompson; and the first teacher and her class in front of the schoolhouse in 1957. (To find out how Thompson has grown, see next page.)

Remember, Inco had to build more than a plant: it had to create a town as well. In fulfillment of its commitment to the Province of Manitoba it had to provide a sub-divided and fully serviced townsite, all in accordance with provincially approved plans. Wisely, before a single house was built by private contractors, the company requested the Metropolitan Planning Commission of Greater Winnipeg to plan the town. This was to be no disorderly collection of shacks rushed up to house the workers and their families: this was to be a carefully thought out community, planned for orderly expansion, in which men, women and children could live happily and healthfully close to their work. The new town was named Thompson in honour of the late Dr. John F. Thompson, then Chairman of the Board of Inco, and in his 50th year of service with the company.

Commercial production of nickel began in mid-1961—four and one-half years after the decision was made to develop the mine. In size it is second only to Inco's Sudbury District operations, but in one way it ranks first: not only is the ore mined, the nickel concentrate extracted and smelted, but it is also refined at Thompson, instead of being sent to the Port Colborne Refinery. This means the finished product can be shipped directly from Thompson to markets all over the world.

Thanks to Inco's continuing process research, the Thompson operation is not only the most modern, but also the free world's first fully integrated nickel processing complex.

To help Thompson become a reality, Inco spent many millions of dollars for such facilities as roads and sidewalks, elementary schools, a high school, a modern hospital, an administration building and fire station, sewage and utilities systems, all of which were given to the community.

As Inco's operations expanded, new businesses arrived, and residential areas grew rapidly. What only a few years ago was a cluster of houses is now a thriving modern community with high-rise apartments, a new city hall, shopping centres and parks. In 1970, during Manitoba's Centennial Year, Thompson became a city.

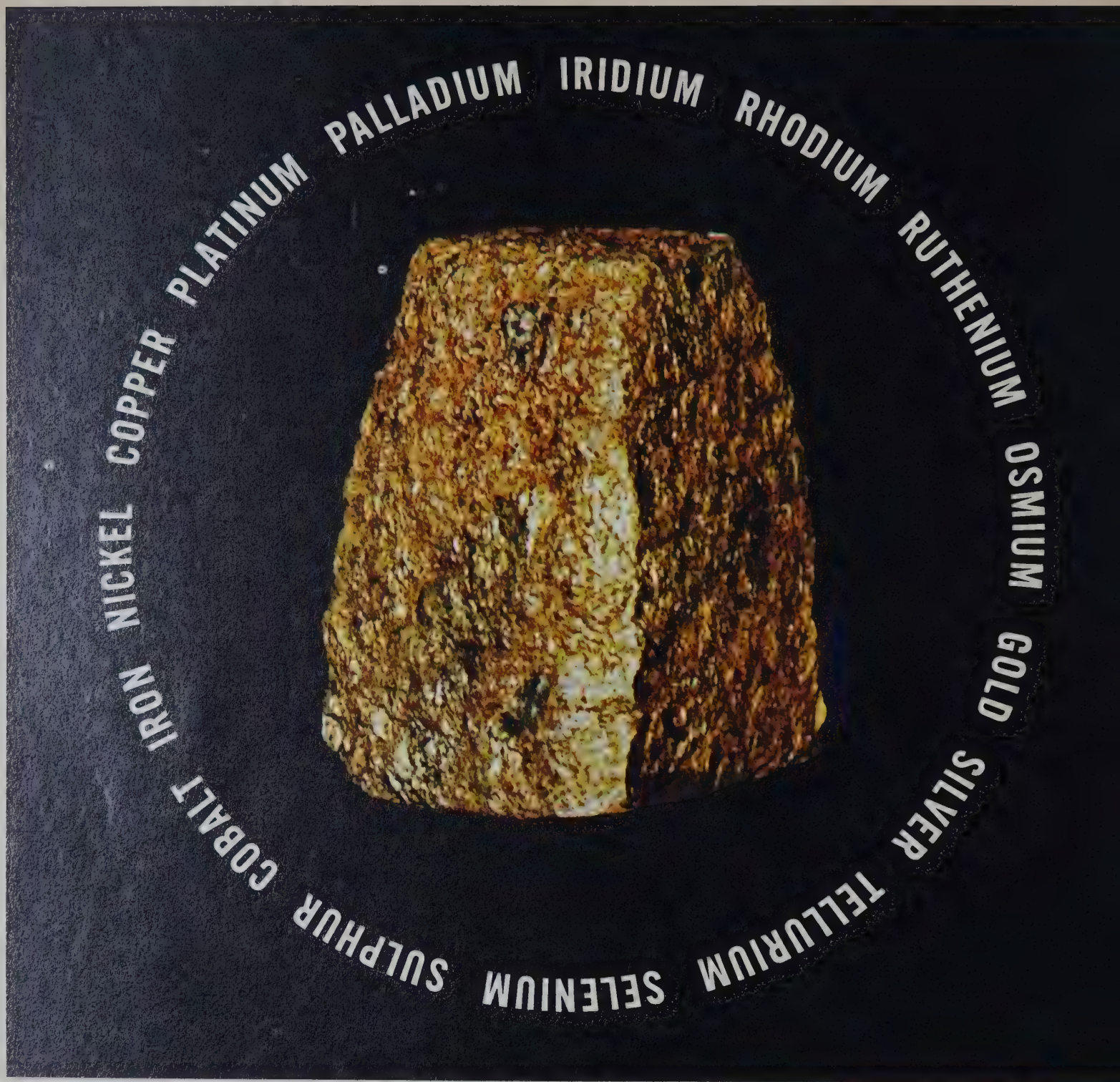
The people who live in Thompson have access to one of the best ski complexes in Manitoba, snowmobile and stock car speedways, a modern marina, and fine fishing in nearby lakes and rivers. They also enjoy lively social activities and most of the amenities of large urban centres.

All these things are just the beginning. People who grow up with the young community regard it as their home and are proud of their contribution to the development of a new area of Canada. Doesn't that make you think of the early days of this nation, when men and women set out from the first settled district to find what lay beyond the lakes and the forests and build new towns and cities for themselves and for those to come after them? It's history being made over again, with parts to be played by boys and girls of today.

Thompson is truly a dynamic community on the move. In a few short years, courageous people with imagination, resources, and foresight carved a thriving community out of the wilderness. The rest of the story will be written in the years ahead, perhaps by some of you who are reading this now.

With the men who opened up the country in the late 1950's came wives and families. In what had once been trees and muskeg, there grew a giant plant and a new town with shopping centers, apartments, modern schools and recreation facilities. In 1970, Thompson became a city—a feat achieved in only a matter of a few years, as shown by the date on the commemorative medal above.


SAFEWAY


IRON NICKEL COPPER PLATINUM PALLADIUM IRIDIUM RHODIUM RUTHENIUM OSMIUM GOLD SILVER TELLURIUM SELENIUM SULPHUR COBALT


Manitoba
Geology
Mining
Concentrating
Smelting
Thompson Refining
Process Technology
The Pas
Hudson Bay
Ontario
Sudbury District
Geology
Mining
Concentrating
Smelting
Iron Ore Recovery
Refining
Process Technology
Winnipeg
Quebec
Shebandowan
Montreal
Sudbury
Toronto
Marketing
Process Research
Port Colborne
Refining
Process Research

Chapter 4

UNLOCKING THE STOREHOUSE

The ore from which the nickel is obtained also contains fourteen other elements. Some have strange-sounding names like selenium, tellurium and ruthenium, with uses ranging all the way from electric eyes to precious jewellery. Inco has developed ways of recovering all these elements, as well as the nickel and the copper, so that during the years the ore has been made more and more valuable.

Now we have said that the nickel ore has been locked up by Nature in her great storehouses under the earth. Like anything else that is locked up—such as money in a safe—the ore is difficult to get at, and then when it *has* been taken out of the ground, it is another difficult job to extract the nickel from it.

Underground mining is a complicated business. There is an elevator, or cage, which takes the miners up and down the shaft. At different levels you will see tunnels running horizontally, driven from the shaft to the ore body. Recently, increasing use is being made of underground ramps, roads like spiral staircases starting from surface. They permit easy movement of large mining equipment and vehicles from one level of a mine to another. All through the mine clean, cool air is circulating, driven down by giant fans from the surface. Each of these tunnels opens out into a much larger opening called a stope. This is the area from which the ore is being mined.

Miners bore holes into the ore-bearing rock in the stope with roaring compressed air drills. These holes are then loaded with explosive and fuses set for ignition. The fuses are lighted, and as soon as the men are safely away, the charges explode. This brings a horizontal section of the stope crumbling to the floor.

Once any loose but unfallen ore has been safely removed (scaled) from the walls and roof after the explosion, the broken ore is transferred to a chute either by mobile equipment (see Page 17) or by a "slusher-scraper". The slusher-scraper is a machine that looks like an enormous mechanical hoe, and it drags the ore over to the chute.

As successive sections of ore are removed in this way, like slices off a loaf of bread, the empty area left behind is filled up with a mixture of sand and cement. This process is known as cut-and-fill mining. Another method of getting out the ore is known as "caving", and then there is "blast-hole" mining, which loosens some 30,000 tons of ore at a time.

At the bottom of the chute the ore is fed into ore cars. These cars run on rails, on one of the lower levels, over to the crusher where the large lumps

The illustration at the top of the facing page shows a piece of ore and the elements Inco recovers from it. Below are pictures of the Pipe open-pit and headframe in Manitoba, and the giant 1,250 ft. chimney at Sudbury. The adjacent map shows the location of Inco's Canadian mines and plants, and their activities.

of ore are broken into smaller pieces to make it easier to hoist to the surface.

Now whichever of these mining methods is used, the next place the ore goes is to large automatic hoists which hoist it to the surface. There it is loaded on the trains of cars which carry it from the mine to the reduction plants at Copper Cliff. At this stage the ore looks like chunks of rock. Hidden in those chunks is the nickel and other valuable metals, and now begins the long process to produce the shiny, white metal which plays such an important part in our daily lives.

First, those chunks of rock are emptied into other giant crushers, which crush them down to small pieces a quarter of an inch or less. On, then, goes the ore into the grinding mills, set in rows in a building several times as big as a hockey arena. Water goes into the mills at the same time, and the ore comes out as finely ground as fine sand.

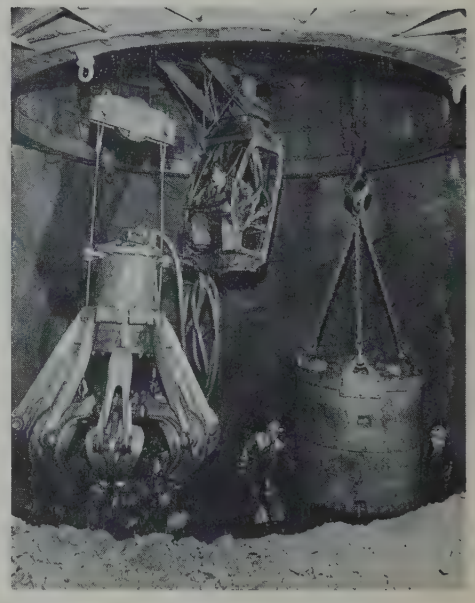
From the grinding mills the crushed and ground ore goes into a long row of tanks, and now begins the process of separating some of those fifteen different elements. First iron sulphide is separated magnetically, and from this material iron ore is recovered by a method developed by Inco research. The other valuable mineral particles are floated away from the useless rock by adding various chemicals and blowing in air. This is called "flotation". These separated parts are called concentrates—one containing most of the copper, another most of the nickel. The separated concentrates then go to the smelter. This is the plant with the giant 1,250 foot chimney, which towers over the countryside. It was built in 1970 and is the highest in the world.

The nickel concentrate, when it arrives in the smelter, contains sulphur, and to get rid of some of this sulphur the concentrate is roasted in enormous furnaces which are several stories high. The material gets hotter and hotter as it flows from the top to the bottom of these furnaces. Then it is melted in a different kind of furnace and some of the impurities in it rise to the surface in the form of slag, which is skimmed off and thrown away, just like skimming the top off a big kettle of home-made jam. But this nickel "jam" is not by any means pure yet. Molten and glowing hot it is poured by giant ladles into what are known as converters, where sand or quartz is added and air blown into it. This burns off still more sulphur and forms more slag, which is skimmed off as before.

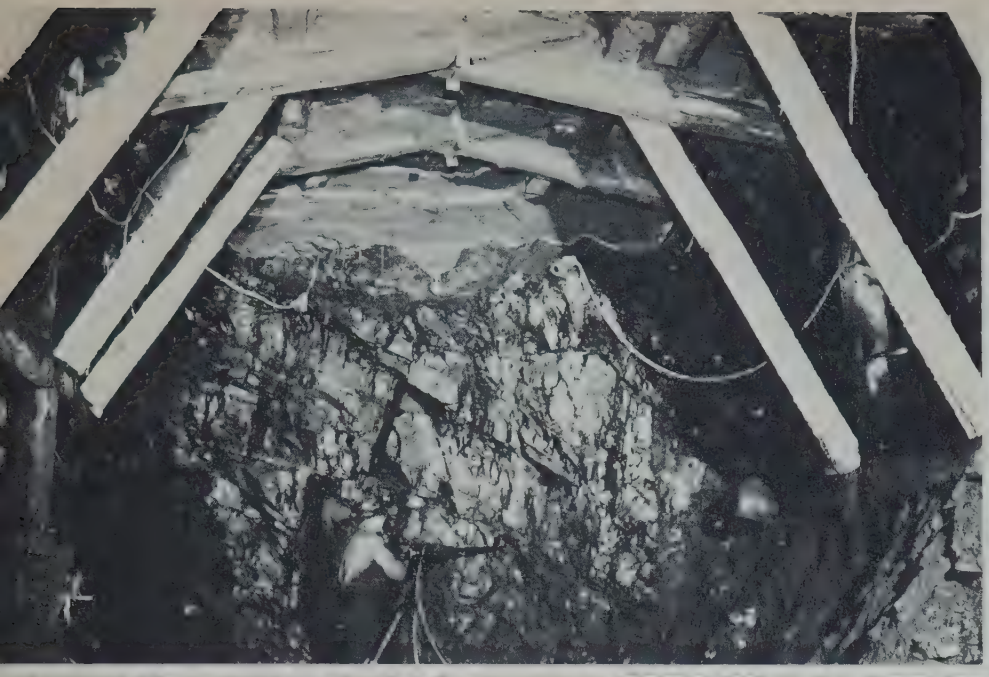
At this point, there is still some copper mixed in with the nickel. These are separated by a slow cooling process, developed by Inco scientists. When the cooling process is over, the nickel and copper sulphides in the matte have solidified independently. The nickel and copper sulphides are now separated by grinding and flotation and each goes its separate way. This matte separation process is another triumph of Inco research.

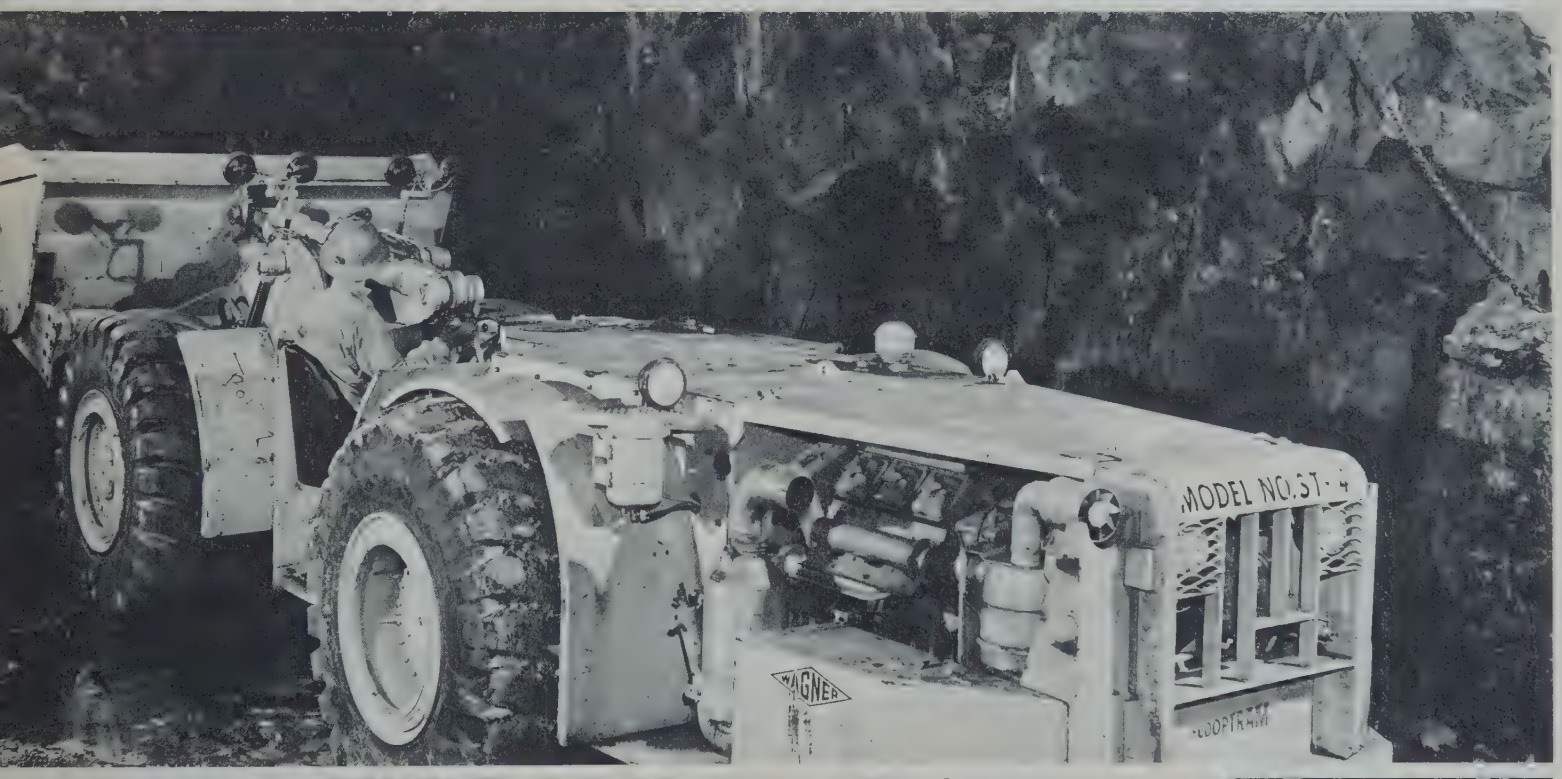
Even now, the nickel is not yet pure. It is in the form of nickel sulphide (with a little copper and iron still mixed in) and by a process known as fluid bed roasting the last remnants of sulphur are driven off and what is left is shipped to Port Colborne, close to Niagara Falls, where it enters Inco's great refinery. There it is reduced to metallic nickel of almost perfect purity—as pure as the nickel coin in your pocket.

First, it goes into furnaces where it is melted and poured into moulds.



Modern equipment and methods, such as those pictured above during the sinking of a new mine shaft, speed recovery of nickel ore. On facing page (top left) is typical undercut-and-fill stope. Note cemented roof which has replaced timber to a considerable extent in this type of mining. On right, drill holes are loaded with grain-size explosive pellets, which are pumped through plastic hose under pneumatic pressure. After blast, special vehicle (centre) moves in to scoop up loosened ore. Mine cars (bottom left) then transfer the nickel ore to jaw crusher (right) which breaks up the large lumps before the ore is sent to the surface.




MODEL NO. 5T-4
WAGNER


INCO
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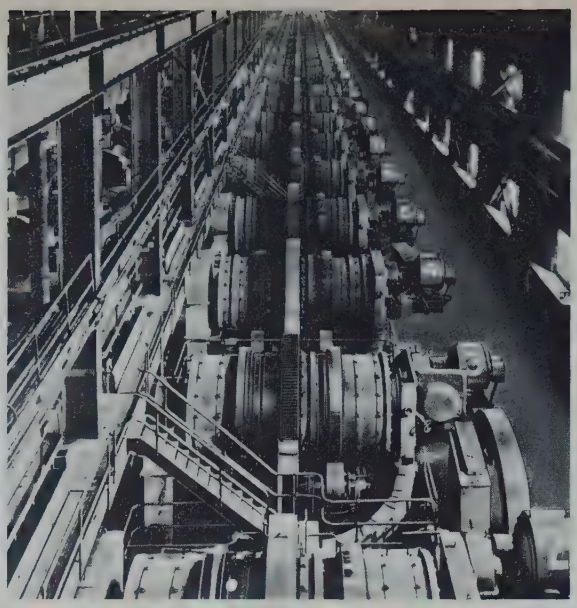
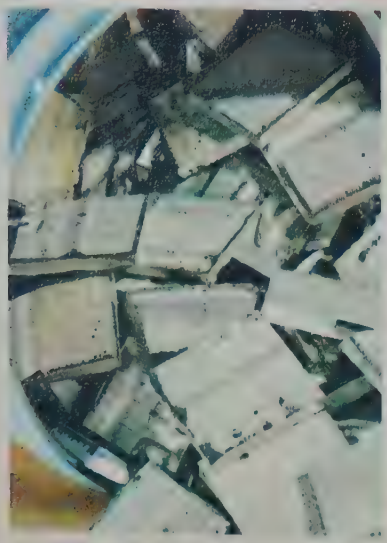
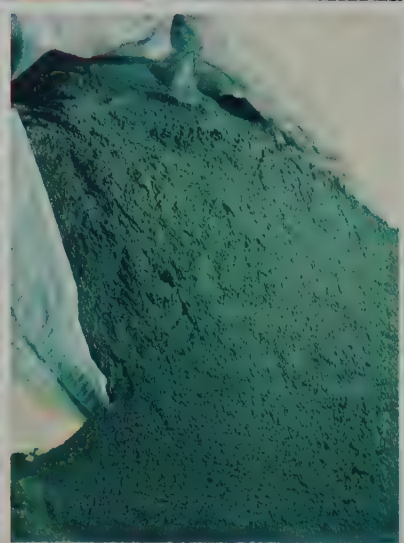







NICKEL
OXIDE
SINTER 90

Here it is allowed to cool in the form of anodes weighing 490 pounds each . . . and this is where the real magic begins. An anode is just another name for a slab of nearly pure nickel which acts as a conductor and is connected to a source of electric power while a cathode is a thin sheet of pure nickel which completes the electrical circuit through an electrolyte. So these impure nickel anodes, along with the cathodes, are lowered into special tanks containing a nickel sulphate-chloride solution and an electric current is turned on. Immediately, the electric current and the solution in the tank get together and start eating away the impure nickel anodes. And where does the pure nickel go? Right through the solution and on to the cathodes, where it builds up and up until large plates of pure nickel are formed, which are then lifted out of the tanks, ready to be cut into sizes convenient for use by various industries, particularly steel plants.

If you are wondering about the rest of those fourteen elements which we told you came out of a lump of ore, some of them are now sludge lying on the bottom of the tank—the ones with the strange-sounding names: palladium, rhodium, ruthenium and iridium, along with platinum, and some gold and silver. They are collected, too, and shipped to other Inco refineries where they are produced in very pure form, so you see there isn't much left of value in that lump of ore that isn't used. But we are concerned here with nickel—that clean, hard, shiny metal which came out of the tank and is ready for the market.

From top (left to right): ore cars leaving mine; giant mills grinding ore to a fine sand; flotation tanks separating the ore concentrates; smelting of the ore concentrates in convertor aisle; the Port Colborne refinery to which Sudbury nickel concentrate is sent; and electrolytic tanks producing the pure nickel in the form of large plates. At bottom of page, nickel in the different forms in which it is sold—squares, pellets, powder, and Sinter 90. Above is section of Copper Cliff laboratory; and at top of page is warehouse from which nickel products are shipped to all parts of the world.

THE MARKET MAKERS

In olden times, when a man had something to sell . . . whether it was something he grew on his land or made with his hands . . . he usually took it to market in a nearby village.

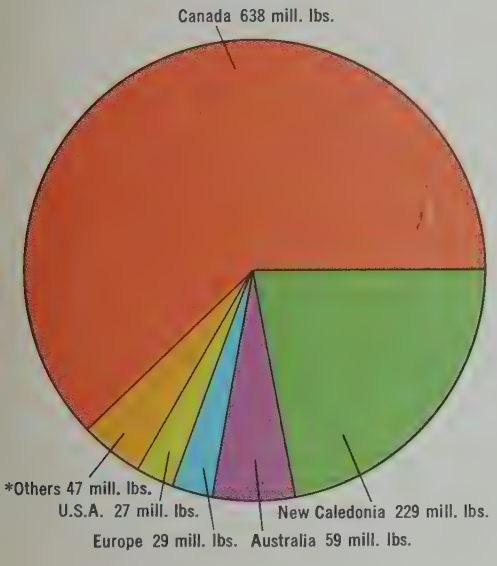
But in the nickel industry today, the whole free world is the marketplace. In cities and towns and villages the world over, people need strong, tough nickel steels and other special nickel alloys to withstand extreme heat and cold or resist rust and corrosion.

Since almost every industry in the world uses nickel and nickel-containing alloys, Inco has trained men in all the world's major industrial centres. These men are specialists who can explain the advantages of nickel and nickel alloys to industrial customers. When new alloys are developed, they must be able to show customers—old and new alike—how and why they should use these alloys. In this way, they help industry to turn out better products, while at the same time helping increase the demand for nickel and ensuring jobs for many Canadians in all walks of life.

Trained metallurgists, scientists and technicians, working in Inco's laboratories or under operating conditions in customers' plants, carry on special tests and experiments to learn everything they can about nickel and nickel-containing alloys. For instance, how certain alloys react to salt water, sulphuric acid, or the many other industrial environments; how best to weld and fabricate these alloys.

Inco scientists also carry on research to develop new or improved alloys for longer life, higher temperature or extreme cold, increased resistance to corrosion and wear. Through constant research, Inco has accumulated a vast fund of information which has been indexed and carefully filed for ready reference. Some of the information is published in the form of

Free world nickel production by geographic origin of ore 1970



**Includes, in order of magnitude: Africa, Indonesia, Central and South America, Philippines.*

On adjacent page (left, from top to bottom): magnifying specimen 1,500,000 times with electron microscope; experimenting in powder metallurgy; specimens undergoing atmospheric tests on sea coast; fusing experimental alloys in vacuum. From top right: Inco's marketing offices in London; research laboratory in New York; testing nickel fungicide in India for control of tea plant disease; frogmen-engineers discuss nickel alloy sheeting for protection of wood piling from marine organisms. Right, a test sample being placed in laboratory furnace, and an X-ray spectrometer which analyzes alloys automatically. Pie chart (above) shows importance of Canada's contribution to world nickel supply.

technical data bulletins and special papers—all for the purpose of helping Inco's customers produce better products at lower cost through the use of nickel and nickel alloys.

Up-to-date information on nickel and its applications is made available to customers through the company's sales and research facilities in key industrial centres in Canada, the United Kingdom and the United States. This information is also made available through offices in Paris, Milan, Brussels, Dusseldorf, Zurich, Madrid, Bombay, Johannesburg, Tokyo, Melbourne and Stockholm.

So you can see what an enormous task is involved today in marketing something as important as nickel.

Spells! Magic! Secret formulae! Not any longer. The alchemy of the past has given way to the science of the present. And Inco scientists look to the future. They know the need for newer and better alloys is a never-ending one. And they carry on never-ending research to provide new alloys to meet the ever-expanding needs of industry.

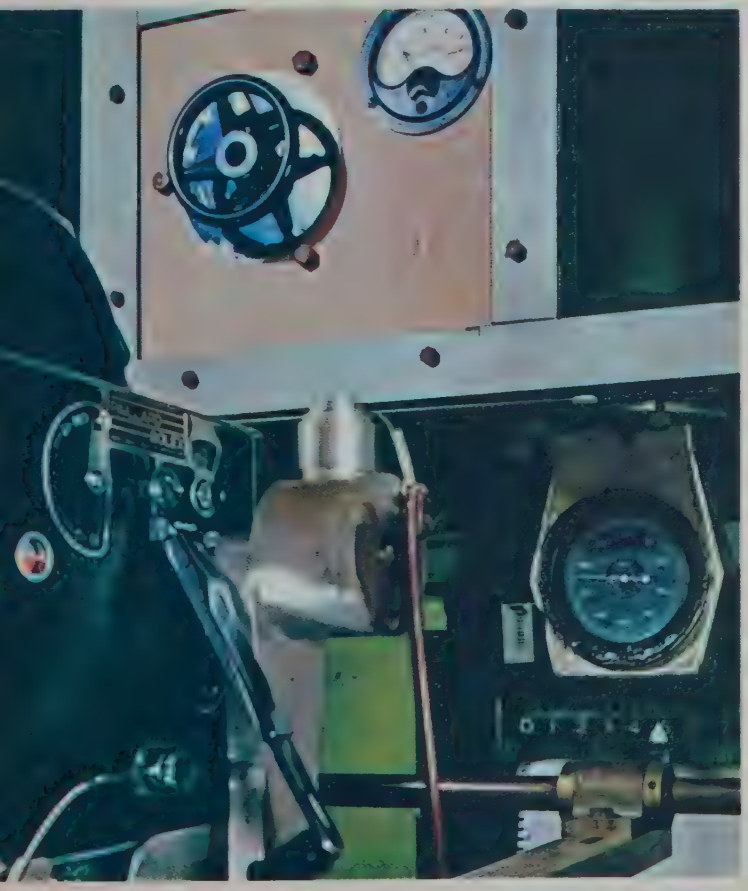
At the same time nickel has to be distributed quickly and efficiently to customers even in the remotest parts of the free world.

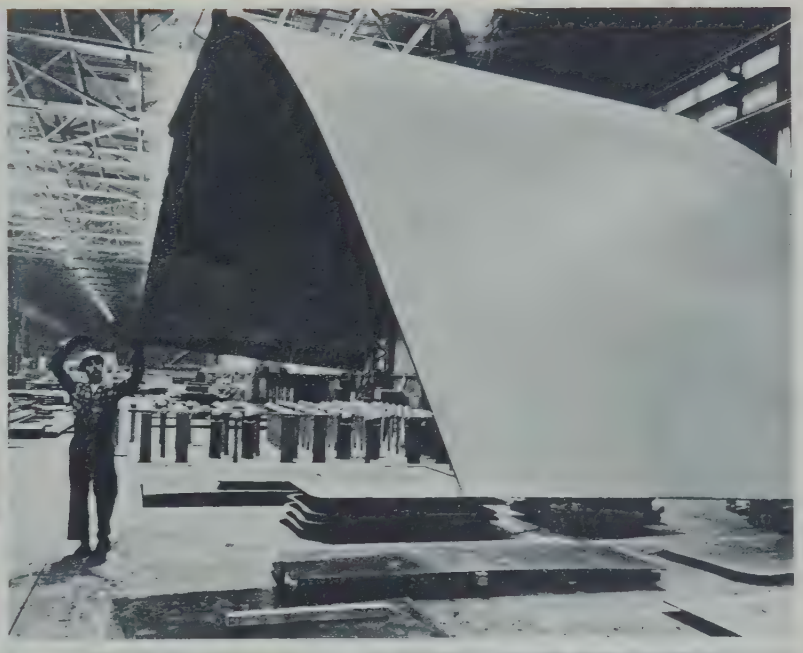
When large quantities of nickel are ordered by steel mills and other regular customers, they are shipped directly by the company. When smaller quantities are needed on short notice, Inco relies on a large number of distributors for nickel and nickel alloys throughout the world.

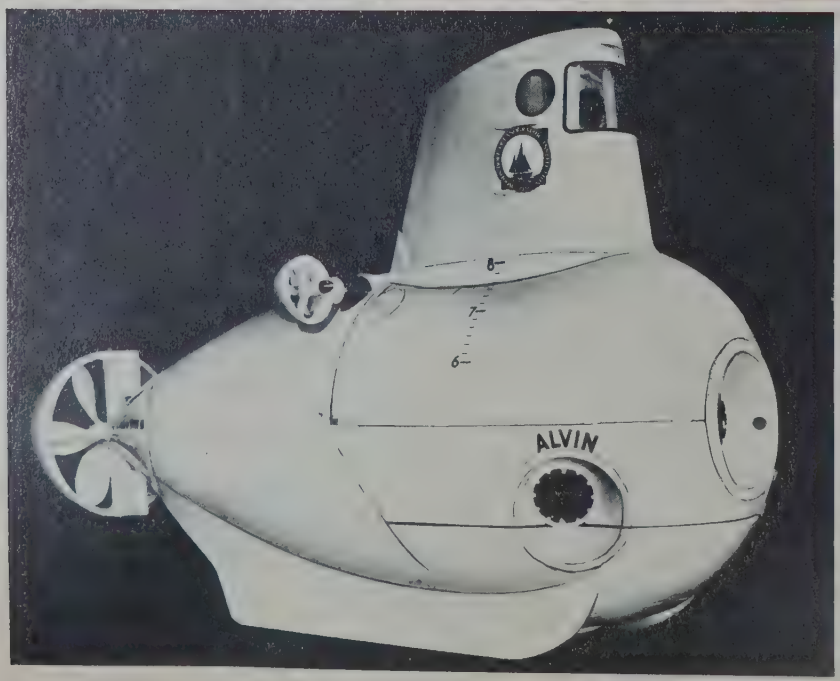
So when a customer in Texas or Bombay wants a nickel product, he doesn't have to wait for it to come from Canada. He can get it from a nearby distributor.

Inco's marketing activities are supported by a carefully integrated advertising and publicity programme using newspapers, magazines, TV, radio, trade and industrial exhibits, special company publications and motion pictures. Some of this material is produced in French, Italian, Dutch, German, Swedish, Spanish, Portuguese and Japanese as well as English. In this way, industries at home and in foreign countries are kept informed about Inco products.

Top left, vacuum melting experiment in British laboratory. Top right, Inco's West Virginia plant produces some 60 different high-nickel alloys for industry, including plate (centre right). Dilatometer (centre, left) automatically records structural changes in steels during cooling. Bottom (from left): Inco specialists confer with project architects during construction of Toronto City Hall; creep machines test resistance of new alloys to creep and rupture; and technician determines gas content of an experimental alloy.



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7
6
ALVIN


2 HENRI-BOURASSA

THE NICKEL WORLD AROUND YOU

Nickel every day—and all day! In thousands of ways nickel has a part in what you use, what you do and what is going on around you. And there's a very good reason for it, because nickel is what you might call a "joiner". It joins up easily with other metals, and in every case it does them good—strengthens or toughens them—protects them against heat and corrosion. Did you know that nickel helped the astronauts get to the moon? The skin of the booster rockets is made of stainless steel with nickel in it; and the shingles on the outside of the space capsules are often made of a nickel-base alloy. The boosters have to withstand temperatures of—297°F to 1200°F. The capsules must withstand speeds of 17,500 mph!

And if nickel will help other metals to stand up to that kind of torture, imagine how easily it will help them to do ordinary, everyday jobs. Watch your father polishing the shining bumpers on that new car of his: it wouldn't be so easy for him to keep it gleaming if the steel under that chromium hadn't been coated with nickel. And in trucks and buses, where the duty is rugged, the important parts of the engine and chassis are strengthened and toughened by the addition of nickel.

There was a time, not long ago, when tableware had to be rubbed and polished with special powder to take off the stains. But that was before someone discovered that combining nickel and chromium with iron produced a metal called stainless steel which could be made into knives, forks and spoons that wouldn't stain or rust.

All through your home, too, nickel goes on working for you out of sight: in your radio, in your television set and in your telephone. Even more imaginative applications where nickel makes its contribution to modern living, include the new life-time rechargeable nickel-cadmium batteries. They are doing away with plug-in cords in a myriad of household items. Take for example your Dad's new electric shaver, his flashlight, his drill, and other power tools. Now he can use them in his car, cottage and boat without worrying about generators, cords or power lines to conventional outlets. With cordless packaged power at her fingertips, your Mother will also be able to use the vacuum cleaner and other household and kitchen appliances with greater ease; she will not have to worry about extension cords or tripping over loose wires when working in the house. To give a life-time of service and many hours of use, these tiny nickel-based power packs need only be plugged for a recharge into conventional electricity outlets for short periods when not in use.

That gleaming coffee pot your Dad gave Mother for Christmas is probably

In the depths of the sea, on land, in the air and in space, nickel alloys are serving man. Nickel gives strength to such deep diving vehicles as "Alvin" (left); corrosion-free beauty to this Montreal subway car; resistance to problems encountered in inter-planetary flight; and (above) safety and strength to critical parts of this Canadian gyroplane.

made of stainless steel, while its heating element, like those on your stove, is no doubt sheathed in Incoloy alloy 800 produced by Inco specially for that kind of heating job. And have you in your home one of those fancy can-openers with a magnet to hold the lid of the can after it's been cut off? There's nickel in that magnet—alloyed with aluminum, cobalt and iron.

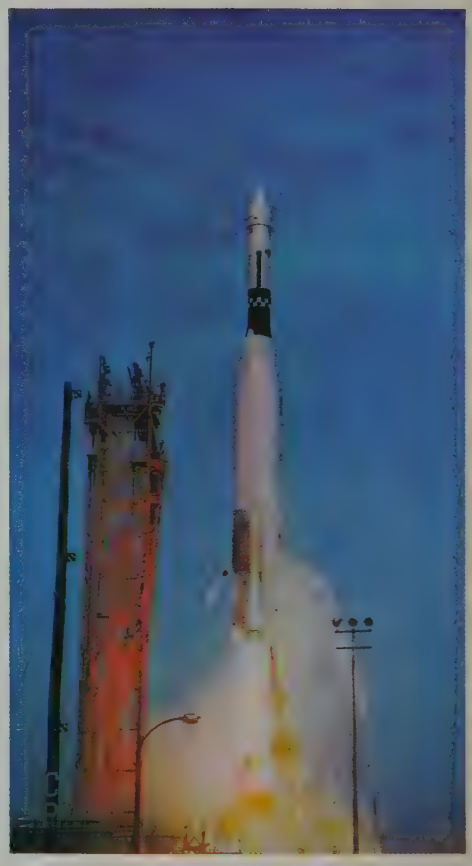
And then, all the way from the hairspring of your watch to the largest steel jobs you can imagine, you will find nickel. Watch one of those great new buildings going up in the city—huge steel girders being lifted and swung into place ten or twenty stories above the street. The crane that's lifting them looks spidery, as if it might bend under the tremendous weight, but the nickel steel it's made of gives it a strength away beyond its appearance. And if you had watched them digging the foundations for that building you would have marvelled how the bulldozers and power shovels down in the hole could stand up to the awful shocks they were taking as they bit into the rock and clay. Nickel again—for steel with added nickel can take it!

Now imagine you're clambering up on the fence to watch the Trans-Continental flash by on its way to Vancouver or Montreal. There's the hooter for the crossing—two longs, a short and a long—and here's the train itself, as clean and shiny and beautiful as the day it made its proud first run... stainless steel or nickel on the job again. Look—there's the dining-car! See the waiters in their white coats setting the tables with knives and forks and spoons and sugar bowls and cream jugs all made of stainless steel or nickel silver, while in the kitchen the food is prepared, cooked and kept hot on tables or in pots of nickel stainless steel.

Back home again it's time for bed, and there we have nickel again, in the heating element of the electric blanket and the works of the electric clock. So there is nickel—around you and with you all day and every day. Did we say in thousands of ways? True—but we can't list them all here... so begin asking around and you'll be surprised how often you find nickel working for you—from the tiny pins in the frame of Dad's glasses to the propeller shaft on Uncle Joe's outboard to the massive girders on a great new bridge...

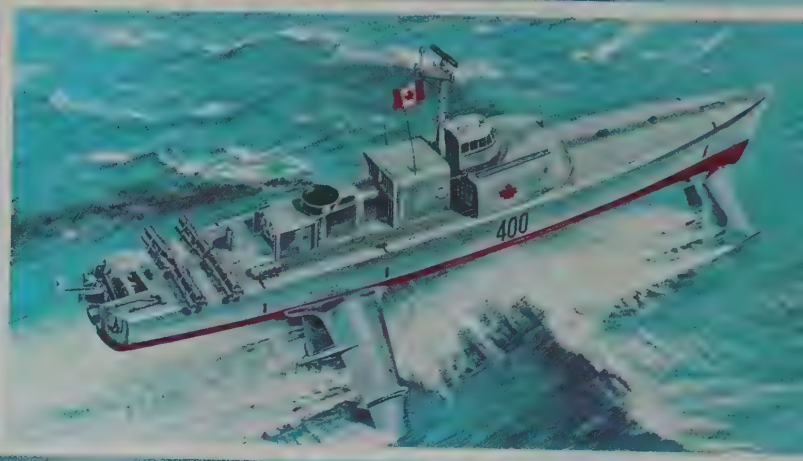
Besides these common uses which are familiar to all of us, nickel and alloys containing nickel have hundreds and hundreds of special uses in industry—to help make paper for the newspapers, books and magazines you read; on farms and in dairies to help keep the milk you drink pure; in big canning factories where the tinned foods you eat are processed; in oil refineries and chemical plants. In practically every industry you can name, nickel and nickel alloys are used to manufacture products you use nearly every day.

Nickel? It contributes to the quality of the products in our everyday life.



Not only does nickel travel with astronauts in space, it also does many critical jobs in the rockets (above) that get them there. On facing page (left to right, from top): nickel is an all-important ingredient in the propellers and turbine power plants of large ocean liners such as the S.S. France (the world's largest); in the stainless steel exterior sections of the Toronto City Hall, the rocket-like Post Office Tower (620 ft.) in London, England, and this modern Pittsburgh building; in the cleanliness and eye appeal of vending machines; in the cast iron block of this high-performance automobile racing engine; in the engines that power today's and tomorrow's aircraft; and in the high-strength components of crawler tractor engines.


AIR CANADA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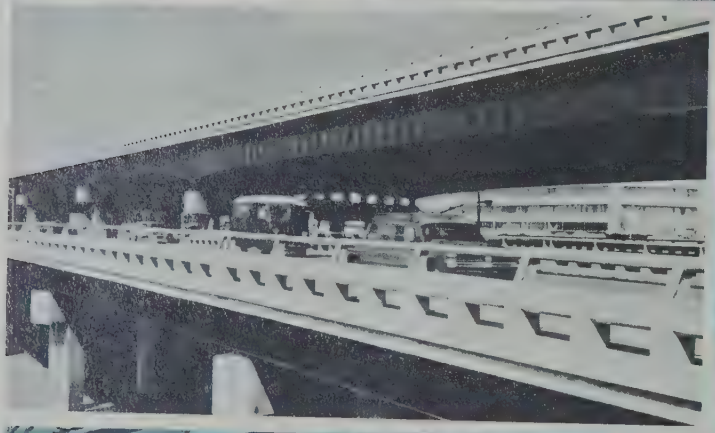
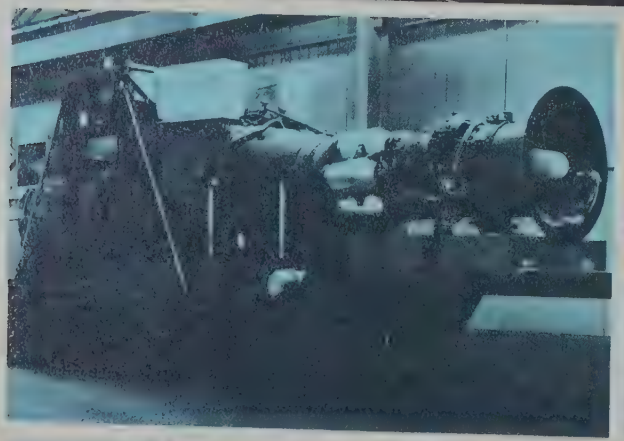
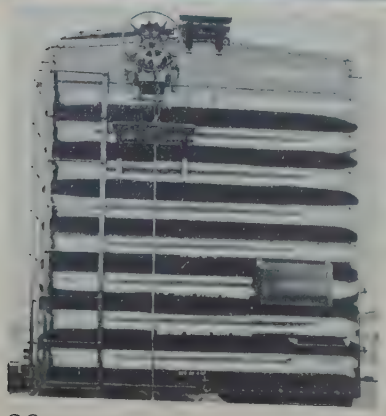
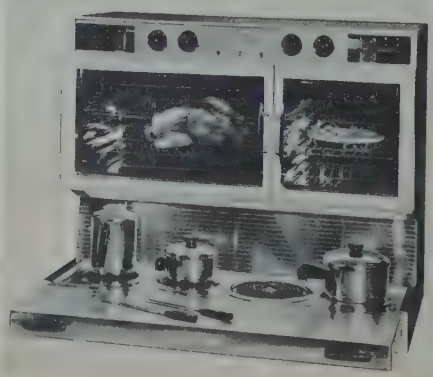
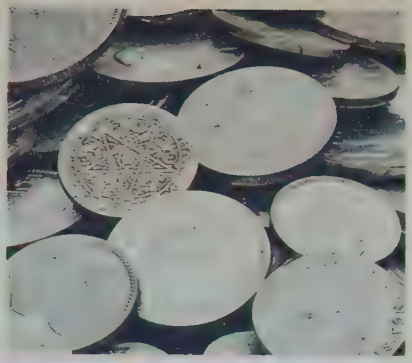


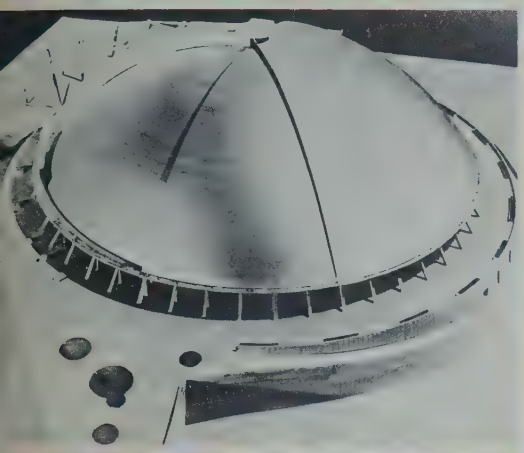



WESTERN









Every day you see or touch many metals without realizing they contain nickel. Take for instance, that trans-continental train (top left). It's covered with nickel stainless steel that won't rust and is easy to clean. Next to it, those bicycle wheels are bright and shining thanks to nickel-chrome plating. The bus, too, has sides of nickel stainless to resist corrosion from road splash and to look modern. Next, nickel also means bright and attractive tableware; and of course nations around the world use nickel in their coinage.

Second row of pictures: nickel helps to beautify today's office furniture; provides strong "flying wings" for hydrofoil ships; and makes practical this proposed auditorium, which has a chromium-nickel stainless steel roof in sections that can be swung back in fine weather. Adding nickel also means the steel in transmission towers can be left exposed to weather, requiring virtually no maintenance.

Third row: nickel is used in the steel for bridges; in many structural parts and engine components of the new breed of vehicles such as hovercraft; in the tough gears of this domestic snow blower; and even in this modern hot dog wagon, which is made of nickel stainless steel for cleanliness and good appearance.

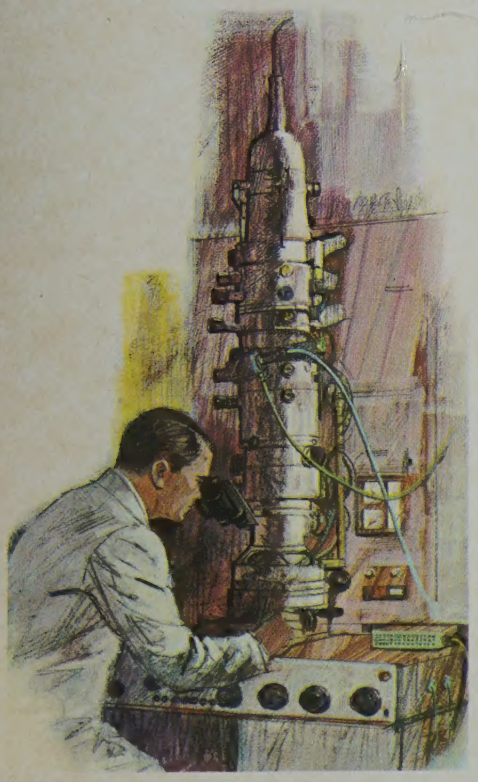
Fourth row: jet engine progress was possible through nickel-containing steels for turbine blades. The world's largest dump truck and (next to it) the world's largest mobile shovel, were designed to take full advantage of nickel's strengthening properties. At the other end of the scale, cordless household items rely on small nickel-cadmium batteries for their power.

Bottom row: boxcar ends are tougher, lighter and easier to fabricate when the metal contains nickel. Telephone kiosks and kitchen stoves look better and last longer because of nickel. It is also favoured by the wine makers, as nickel stainless steel storage tanks do not affect the flavour of the contents. There is nickel stainless on the farm, too, because it resists corrosion by chemical fertilizers; and fountains of nickel stainless stay rust-free and bright.

YOU... NICKEL...AND TOMORROW

In times to come your lives will be enriched by the discoveries of Inco's development and research facilities. Many physical and chemical secrets of metals and alloys remain unsolved and these facilities of Inco—which have already solved many of them—will go on to discover many more. For such are the ways of progress . . . and such are the needs of the future. With astronauts circling the earth . . . with moon landings . . . the world will require remarkable new materials and men of great genius in the years to come.

Conscious that every ton of ore mined must be replaced by new finds, Inco is continuing its relentless search for new nickel deposits. To find them, the company works in many parts of Canada. A large portion of this search is concentrated in the far northern and Arctic regions. The modern pioneers, who work there, are every bit as venturesome as any explorers of old. But unlike the mine seekers of yesteryear, who were handicapped by weather, ground conditions and distances, Inco exploration crews today are moving swiftly in planes and helicopters, peeking under the surface of the earth with the most modern scientific instruments, many of which were developed by the company. They are methodically and scientifically combing many areas of Canada and the world, examining spots where nickel is thought likely to be found. Like Mounties on the trail of a wanted man, they persistently follow every clue. Sometimes it takes months, sometimes it takes years of hard work to find a worth-while deposit, because to make mining economical it is not enough to find some nickel. The deposits must be substantial enough to warrant their development or otherwise it may cost more to build a plant, extract the ore from the ground, treat it and ship the nickel to markets, than can be realized for it.



Throughout Canada and other parts of the world, Inco's search and research continue without pause. On foot in the woods, by air with helicopter and with airborne magnetometer, by sled in the frozen north, and in the jungle heat of tropic lands, men are searching for fresh deposits of nickel. In new laboratories, such as the one (shown left) near Toronto, others are seeking the new methods and new alloys of tomorrow.

But when the earth finally yields such a hidden treasure, as happened at Thompson, new jobs are created for thousands of people. They built towns and railways in the wilderness and now they are working in the mines and plants to extract and refine the ores. Others develop markets for the nickel in Canada and abroad. Others yet, are seeking new ways of adding nickel to other materials to make better and stronger products, needed by industry to cope with the developments of modern technology. By searching for nickel, mining it, refining it, selling it, and finding new uses, Inco's operations in Canada provide jobs for many thousands. Together with their families and dependants, over 100,000 people derive their livelihood directly from the company's operations. In Canada Inco pays its employees more than $250,000,000 a year in salaries and wages.

But that is not all. Thousands more are engaged in making and supplying other products which Inco needs: roof bolts for mine support, railway cars for carrying the ore, furnaces for smelting it, machinery and equipment for all stages of refining, chemicals for purifying it, explosives for the mines, paint, gasoline, fuel oil and lubricants, modern safety equipment, etc. For operating purposes, goods and services purchased by the Company amount to $220,000,000 annually. This is in addition to money spent on new mines, plants and equipment and which recently ran as high as $230,000,000 a year. Another $26,000,000 a year is spent on transportation.

On top of all that, still more thousands of people are employed as grocers, doctors, electricians, bus drivers, nurses, and in many other ways, all providing goods and services to the company and its employees. When you think of all these people, directly or indirectly obtaining their livelihood from Inco operations you can visualize the impact the company is making on the Canadian economy, and the country as a whole.

It is easy to see what this means to Canada. But what does it mean to you? Well, Inco represents one of the great fields of opportunity for you to enter when you leave school. Canada is not just a string of cities along the border; it is still a country with hundreds of thousands of square miles to be explored and developed. Who knows how many more of Nature's treasure-houses await the coming of adventurous young men to unlock them? And if someone does find a great new deposit up near the Arctic Circle, for instance, it will take the strength and courage and scientific skill of hundreds of young Canadians to get the treasure out and to make it possible to live and work in that far northern country.

Maybe such a job is for you. Or maybe you see yourself quietly at work in a modern, well-fitted laboratory on the trail of new techniques to improve the mining or the refining or the use of nickel. If you are strong and rugged, and like to work with machinery, perhaps you can see yourself down there on the two-thousand foot level, in at the start of the whole operation—the man who actually wrests the treasure from the storehouse where Nature locked it. Or you may see yourself at work in one of Inco's offices in Canada or in one of the other 17 countries around the world.

To help play your part in Canada's future development, and to help equip you to seize the opportunities as they occur, Inco has set up scholarships at Canadian universities, available to high school graduates. This is Inco's way of helping deserving boys and girls to obtain a university education.

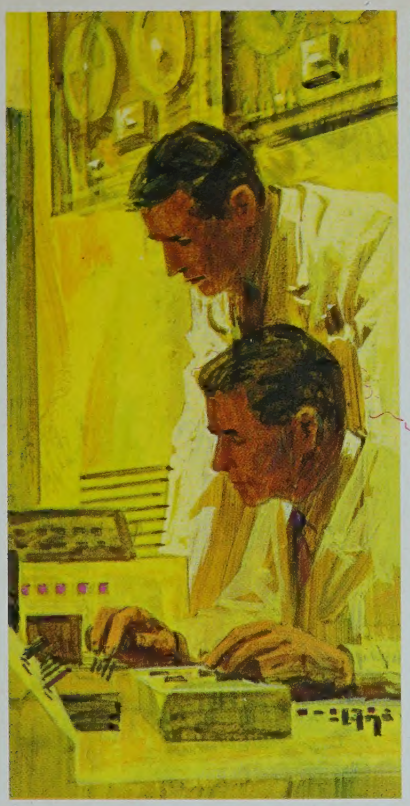
In other lands they say that today the spotlight is on Canada. We at Inco believe that to be true. Shining in that spotlight are Canada's great mineral treasures, of which nickel is one of the greatest. Canada is called the Country of Tomorrow, and we know that no matter how bright that tomorrow is nickel will play a tremendous part in it. Nickel has an exciting past, but its future will be even more exciting . . . for Canada and for you.

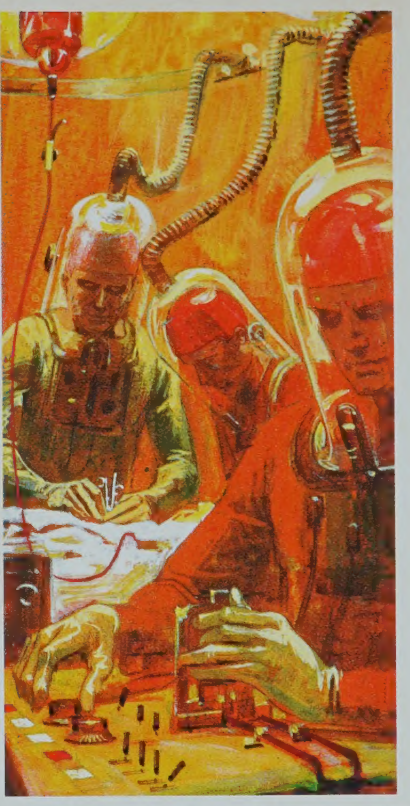
"I do not know whether the overall pace of future events will accelerate and outdistance that of recent years, but if we grow in the next decade as we have in the past, I know only one way for management to insure our future in this environment. That is to make every effort to have and to develop strong, talented people—and enough of them—in our organization.

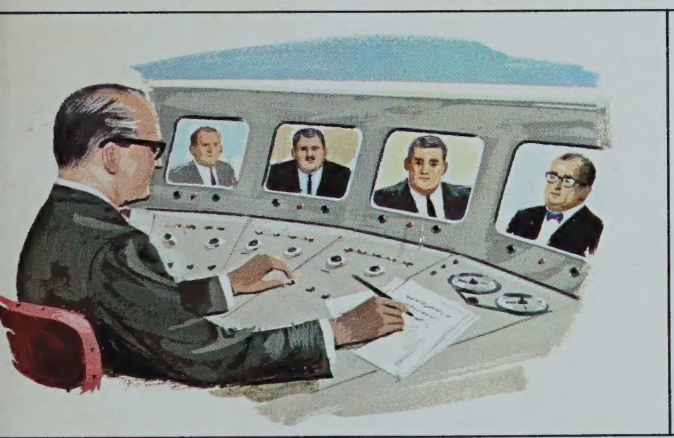
"We require people with broad and specialized skills in mining and extractive metallurgy, in the natural and engineering sciences, people skilled in marketing, in accounting, in government relations, in finance, in commercial and other affairs."

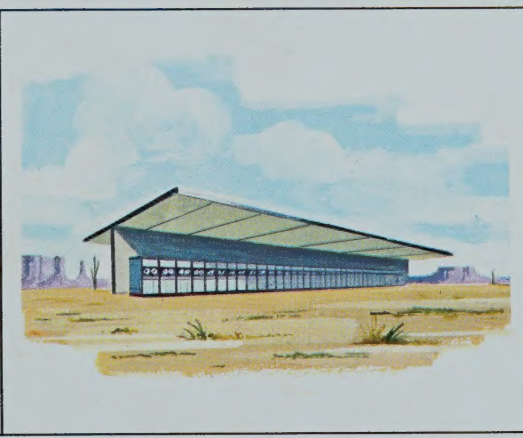
H. S. Wingate
Chairman and Chief Officer
The International Nickel Company of Canada, Limited

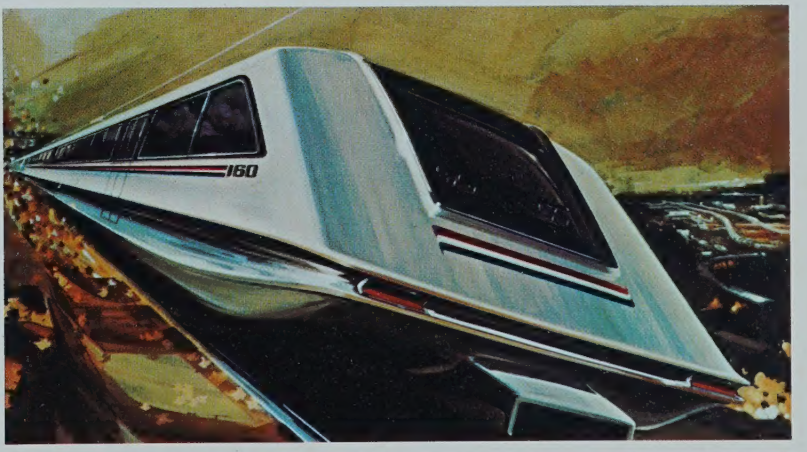
When some of today's visions portrayed here become realities tomorrow, nickel will have helped make them possible. From top (left to right): instant diagnosis by hospital computers, whose memory banks will contain the 10,000 known diseases, each of which has 600 or more symptoms; nuclear-powered pacemakers implanted in heart patients; your own blood, frozen when you are well, will be banked away against the time you need a transfusion. Centre: "remote control" business conferences; vast memory banks, placed where land is cheap, and tapped in seconds; orbital postmen in satellite form for relaying messages. Bottom: the new Atlantis in which men will live and work on the ocean's floor; supertrains rocketing between cities; and electric aircars for crowded urban areas.







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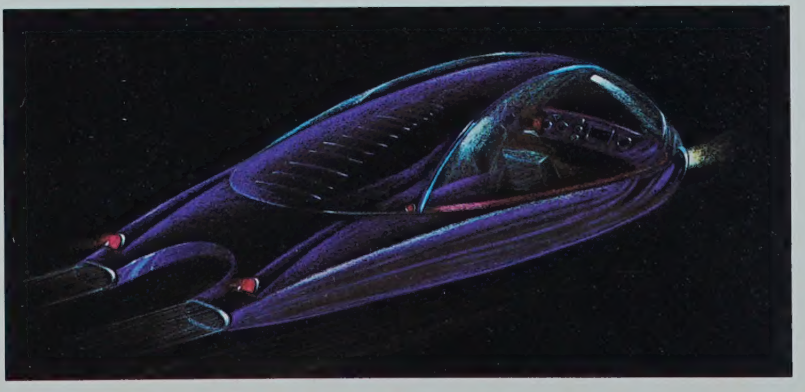

NICKEL

I am the often unseen ingredient that transforms metals into more than 3,000 different alloys and coatings with properties superior to those of the base metals themselves.

Alloys to stand white heat that would melt many other metals . . . alloys to endure the embrittling action of sub-zero cold.

Alloys that make the most powerful magnets known . . . alloys no more magnetic than wood.

Alloys that can be intricately shaped by whirring lathes . . . alloys so hard they cut glass.

Alloys for thermostats that stretch with heat or shrink with cold . . . alloys to make fine watch parts that never change a millionth of an inch.

Alloys to handle destructive caustics and acids that dissolve rocks as if they were lumps of sugar . . . alloys to protect the delicate purity of sensitive drugs.

Alloys with low electrical resistance . . . alloys with high resistance that make electrical cooking and heating practical.

I mingle alike with common cast iron and precious metals.
I strengthen the tiny pin in eyeglass frames and the massive girders in great bridges.

I am in the meteorites of the heavens, and the far depths of the earth. You find me working all around you, unseen . . . in the notes from your radio, the voice on your telephone, the whiteness of your linen, the purity of your food, the power of your car, the light in your electric bulbs, wherever you may look. All these are my work.
I am nickel.

LITHOGRAPHED IN CAN